Field measurement of coefficient of friction in rails using a hand-pushed tribometer

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Abstract: The coefficient of friction (COF) in wheel/rail contact strongly influences the performance of the train since it determines the available traction force. In this work, the COF at the wheel/rail interface of a commercial railway was measured in the field using a hand-pushed tribometer. Two different friction modifiers and water were manually applied on the top of the rail and gauge prior to the tests and creep curves were obtained for several contact pressures ranging from 1.0 to 1.2 GPa.

The results showed that the values of coefficient of friction in the field were among 0.1 and 0.7 depending on the product applied to the interface. For dry tests, the coefficient of friction was among 0.5 and 0.7 depending on the surface roughness and the presence of oxides in the rail's surface. For water lubricated tests, the COF was among 0.4 and 0.5. On the other hand, when oil-based friction modifiers were applied to the rail's surface, the COF was reduced to values ranging from 0.1 to 0.35. The highest COF values were measured when a friction modifier developed by the authors was used (Friction Modifier 2). The results also showed that the COF depends on the thickness of the layer applied to the rail's surface. When a thick layer was applied, the coefficient of friction was reduced in more than 30%. Additionally, it was found that when the contact pressure was increased the rise in COF was proportional. The results agreed with the values of COF reported in the literature using other hand-pushed tribometers for dry and water lubricated tests [1]. However, when the results were compared with those obtained in twin disk tests in laboratory [2], the latter ones were lower in all cases.

1. Introduction

Reliable assessment of COF at the wheel/rail interface is a key factor to control the available traction force and to improve the performance of the system. It is well known that the presence of friction modifiers and/or lubricants at the interface drastically changes the tribological response of the contacting pair and helps increase the durability of the components while it reduces prejudicial effects such as noise and rail corrugation.

2. Experimental

COF measurements were performed in the field using a custom-made hand-pushed tribometer. The operating principle of the equipment is to progressively increase the braking torque on a wheel to induce longitudinal slip with respect to the rail. The COF is calculated as the ratio of the tangential force (which is a function of the braking torque) to normal force (measured with a load cell) for every creepage (measured with an encoder). Figure 1 illustrates the principle of operation of the tribometer. The relative sliding speed was 0.5 ms^{-1} in all cases and the contact pressure varied between 1.0 to 1.2 MPa.

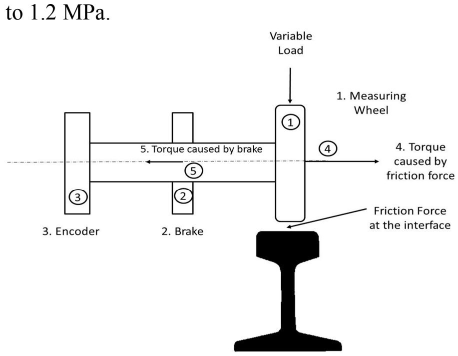

Figure 1. Scheme of measurement principle

3. Results

Figure 2 shows the creep curves for the dry condition and for lubricated conditions with water or friction modifiers manually applied to the top of the rail. Figure 3 shows the average COF values obtained from the creep curves in each case. In both figures the mean contact pressure was 1.0 GPa.

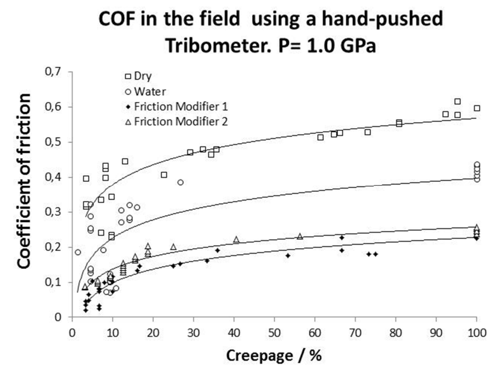

Figure 2. Creep curves for different interfacial conditions.

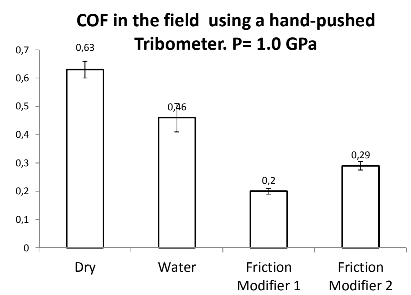

Figure 3. Average COF for different interfacial conditions. Average of eighteen (18) successful measurements.

4. References

[1] H. Harrison, T. McCanney, J. Cotter. Recent developments in coefficient of friction measurements at the rail/wheel interface Wear 253 (2002) 114–123

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